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SKINNER'S VERBAL BEHAVIOR, *CHOMSKY'S REVIEW, AND MENTALISM*

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Skinner's *Verbal Behavior* (1957) is a comprehensive treatise that deals with most aspects of verbal behavior. However, its treatment of the learning of grammatical behavior has been challenged repeatedly (e.g., Chomsky, 1959). The present paper will attempt to show that the learning of grammar and syntax can be dealt with adequately within a behavior-analytic framework. There is no need to adopt mentalist (or cognitivist) positions or to add mentalist elements to behaviorist theories.

Key words: verbal behavior, grammar, B. F. Skinner, N. Chomsky, behaviorism, mentalism, cognitivism

Although Skinner's *Verbal Behavior* (1957) is a comprehensive treatise that deals with most aspects of verbal behavior, Chomsky's (1959) review of the book was extremely critical; he suggested that the book demonstrated the failure of behaviorism. The review was very influential, and many psychologists accepted its conclusions. The effect was an abandonment of behaviorist principles and the ready acceptance of mentalist (or cognitivist) approaches among most of the intellectual community.

About 10 years later, MacCorquodale (1970) published a reply to Chomsky in which he answered most of Chomsky's arguments, but the effects of this reply were minimal. Why had MacCorquodale's paper so little impact? There are probably various reasons (see, e.g., Czubaroff, 1988), but one is apparently crucial. Although MacCorquodale showed that a large number of Chomsky's objections are unjustified, his answer to the main objection, namely Chomsky's critique of Skinner's account of the learning of grammatical behavior, was unsatisfactory.

In this paper I will argue that Chomsky's objection is invalid. A Skinnerian framework can indeed account for grammatical behavior, and there is no need to adopt mentalist approaches or to add mentalist elements to behaviorist principles (cf. Killeen, 1984). Before dealing with grammatical behavior, however, it is important to examine some basic aspects of the learning of words.

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THE LEARNING OF WORDS

According to Skinner (1957), children learn to say words such as *red* (pp. 84–85), *chair* (pp. 91–92), *pyramid* (p. 107), and *familiar* (p. 136) with the help of appropriate reinforcing contingencies. The contingencies establish the control of the responses by certain stimuli. Establishing stimulus control frequently has generic effects; the responses are evoked not only by identical but also by *similar* stimuli, that is, stimuli that share certain properties with the original stimuli (e.g., Skinner, 1953, pp. 132–134; 1957, pp. 91–92). I will say that the classes containing similar stimuli are the organism's *generalization classes* relative to the original stimuli (for a more precise definition of this term, see Stemmer, 1980, 1983, 1989).

The properties that control words such as *red, chair,* and *pyramid* are physical properties, whereas other words, such as *familiar,* are controlled by other properties. Thus, Skinner observes that a

> familiar place is not anything distinguished by any physical property. It is familiar only to someone who has seen it or something like it before. Any place becomes familiar when frequently seen . . . the condition responsible for *familiar* is not in the stimulus but in the history of the speaker. Having acquired the response with respect to this property, the speaker may emit it in the presence of other objects frequently seen. (1957, p. 136)

The word *familiar* is thus controlled by a nonphysical property, the property "to be an object frequently seen by the speaker." This property

has acquired controlling power because of certain events in the speaker's history.

Skinner does not discuss in detail the historical (ontogenic) contingencies that give controlling efficacy to nonphysical properties, but they are investigated in experiments on stimulus equivalence (see, e.g., Dixon & Spradlin, 1976; Sidman & Tailby, 1982; Sidman, Wilson-Morris, & Kirk, 1986). The contingencies that have this effect in Pavlovian conditioning are described by Quine (1974) and Stemmer (1971, 1973, 1980, 1983). I will use the term *functional properties* to refer to nonphysical properties that have acquired controlling efficacy.

Functional properties play an important role in verbal behavior, because they control such responses as *familiar, toy, clothes, tool,* and so forth. However, it is important to realize that attributing controlling efficacy to a functional property must always be justified. Because the efficacy derives from specific contingencies, one must always be able to show that the speaker's history indeed includes the relevant contingencies.

It often happens that the property that controls a child's verbal response is not identical to the property that controls the response in the verbal community. In particular, the child's controlling property may determine a generalization class that is wider than the class determined by the community's controlling property. According to Skinner, in this case the community resorts "to another behavioral process which sharpens stimulus control and opposes the process of extension. It reinforces responses in the presence of a chosen stimulus property and fails to reinforce, or perhaps even punishes, responses evoked by unspecified properties" (1957, p. 107).

Punishment or nonreinforcement does not immediately establish the correct controlling property. Because stimuli usually have several properties, sharpening the control of a particular property may take several training sessions. During these sessions the organism tries out different discriminative properties until it arrives at the correct property or at the correct combination of properties (e.g., Skinner, 1953, pp. 134–136; 1957, pp. 107–108, 117–119). As is suggested by experiments on attention and cue-distinctiveness (e.g., Skinner, 1953, pp. 122–124; Mackintosh, 1974; Sutherland & Mackintosh, 1971), the more *salient* a property is for the organism, the higher the probability that the property will be tried out by the organism. (Actually, it is the other way around. We call *salient* those properties that have a high probability for becoming discriminative properties [cf. Skinner, 1953, p. 122]. Still, the notion is useful because it is possible to determine standards of salience [for an organism or for a species] on the basis of independent experiments on discrimination [cf. Quine, 1974, pp. 25–28; Stemmer, 1983, pp. 33–34].)

In addition to learning to *say* words, children also learn to become effective listeners. According to Skinner, the learning processes are basically Pavlovian conditioning processes. These give the listener the ability to react to the verbal stimulus "with conditioned reflexes . . . or by taking action appropriate to a given state of affairs" (1957, p. 357). For example, a child can become an effective listener with respect to the word *Jones-plug*

> by watching someone working with electrical apparatus while describing his own behavior as he does so. . . . The effect upon the listener is not only to establish *Jones-plug* as an appropriate tact but to set up nonverbal behavior in response to similar stimuli, for example, behaving correctly when asked *Please hand me a Jones-plug.* (1957, p. 360)

The contingency described here by Skinner is a typical Pavlovian contingency. The subject is exposed to the pairing of two stimuli: the verbal stimulus *Jones-plug* (within some verbal context) and the concrete Jones-plug. As is pointed out by Skinner, such contingencies usually have two effects. First, they set up appropriate nonverbal behavior in response to similar verbal stimuli, for example, to further utterances of the word *Jones-plug* (perhaps within an appropriate verbal context such as in *Hand me a Jones-plug*). That is, the person becomes an effective listener with respect to the verbal stimuli. Second, the contingencies establish the verbal stimuli as appropriate tacts. The effective listener also becomes an effective speaker with respect to the verbal stimuli. Pavlovian contingencies that have these effects will be called *ostensive contingencies* (cf. Skinner's use of the term *ostensive definition,* 1957, p. 360).

Stimulus control can also be sharpened for a listener. The child who points to a horse

when being asked *Show me a dog* will usually not receive reinforcement or may even be punished. (For a brief comment on punishment in Pavlovian conditioning, see Skinner, 1957, p. 108.)

Except for a few words, such as *Daddy* or *Mommy,* children do not appear to utter the words of natural languages spontaneously. Most words are probably first learned by children as listeners. It is likely, however, that the sharpening of the stimulus control often takes place when the children perform as speakers. It gives the community more opportunities to correct them. (There are, however, cases of children who have become listeners without becoming speakers [see, e.g., Lenneberg, 1962]. This, together with the fact that most words are probably first learned by children as listeners, suggests that the study of the processes by which children become effective listeners is of the greatest importance for a correct analysis of verbal behavior.)

CONTEXTUAL LEARNING

I mentioned above that words controlled by salient properties are easier to learn than words controlled by "weak" properties. Salience can be enhanced. Consider, for example, the word *holds.* It is unlikely that hearing isolated utterances of *holds* while a holding relation is exemplified (e.g., the holding of a ball by a person) will establish a holding feature as a controlling property of the word. The feature is insufficiently salient. Nevertheless, an appropriate verbal context may heighten its salience. Suppose a girl has already learned the words *Mommy* and *the ball,* but has never heard the word *holds* (or other variants of the verb *to hold*). The girl is now looking for her ball (e.g., she emits *Ball?*), and her father responds *Mommy holds the ball.* Hearing this utterance will direct the girl's attention to the objects named by *Mommy* and *the ball*—the mother and the ball—and consequently to the specific relationship in which the two objects stand: the physical state of affairs that we call "holding" in our everyday language. The verbal context will give sufficient salience to this relation. Therefore, the ostensive contingency (or a number of such contingencies) will transform the girl into an effective listener with respect to the structure (or pattern) *x holds y*: The structure will be controlled by holding relations. This concept of structure corresponds to what Skinner calls functional unity (1957, pp. 119–120) or partial frame (1957, p. 336).

This account of the learning of structures such as *x holds y* is an hypothesis; hence, it cannot be shown to be true. It has, however, a high degree of plausibility, because (a) it is based on reasonable extrapolations from experimental results; (b) the behavioral effects are attributed to conditioning processes rather than to "operations of the mind"; and (c) no mentalist assumptions are made, because all theoretical notions that have been used in the account have been defined operationally. (Most of the definitions are adapted from Skinner, 1953, 1957.) Moreover, there seem to be no alternative hypotheses that account for the learning of expressions such as *holds, receives,* or *is smaller than* that are more plausible. This suggests that the above account, which agrees with Skinnerian views, is sufficiently plausible to be accepted.

Let us now examine the learning of other words that are controlled by weak properties, namely, words such as *which* or *who.* We will see that these words frequently play an important role in grammatical behavior. I will concentrate on the word *which.*

Suppose that a girl has never heard utterances of *which,* but already understands the other words that occur in *Please, give me the book which is on the piano.* I am using here the word *understands* in the sense defined by Skinner (1957, p. 277) according to which the "listener can be said to understand [a word] if he simply behaves in an appropriate fashion" [with respect to utterances of the word]. The girl's father now says, *Please, give me the book which is on the piano,* and there is indeed a book on the piano. This contingency (or several of such contingencies) will transform the child into an effective listener with respect to the structure *x which y,* because the verbal context calls the girl's attention to the particular relation that is being expressed by this structure. In other words, with the help of the verbal context, the contingency brings the structure under the control of a subtle property of the environment. This account is again merely an hypothesis, but because it has the features mentioned in connection with the learning of *holds,* we can conclude that it, too, is sufficiently plausible to be accepted.

GRAMMATICAL GENERALIZATIONS

Let us now turn to Chomsky's argument against behaviorist theories in general and Skinner's theory in particular. I will state here the essential part of the argument, while also taking into account the versions of the argument given in Chomsky (1957, 1965, 1968, 1975, 1986). Consider so-called passive sentences such as *The book is held by Mommy* or *The lecturer is interrupted by John.* Speakers often emit verbal responses consisting of new passive sentences (i.e., passive sentences that they have not previously heard). Because these responses are new, they have not been reinforced previously. Similar facts hold for listeners; effective listeners can understand passive sentences even if they have never heard them. Analogous conclusions hold for other sentence forms such as questions or negatives. People emit interrogative responses on the appropriate occasions, yet these questions are often new in the sense that they were not reinforced previously. Similar facts hold for listeners.

Chomsky's argument now can be expressed in the following way. He assumes that the "creative" capacity to understand and produce new sentences derives from the grammar that we have internalized. "We understand a new sentence, in part, because we are somehow capable of determining the process by which this sentence is derived in this grammar" (Chomsky, 1959, p. 56). Now Chomsky (1957) had shown that grammars consist of very complex structures, and he believes that the acquisition of a *structure-dependent* grammar cannot be explained as the result of a process of generalization of the type studied by Skinner (or other behaviorists or so-called empiricists). He concludes therefore that Skinner cannot account for our creative verbal capacity and that the capacity seems to be largely genetically determined. "The fact that all normal children acquire essentially comparable grammars of great complexity with remarkable rapidity suggests that human beings are somehow specially [innately] designed to do this" (Chomsky, 1959, p. 57).

Skinner does not deal explicitly with the processes by which people acquire this "creative" power, but his analysis of the learning of grammar (1957, pp. 331–334) suggests that he indeed attributes it to a process of generalization. MacCorquodale explicitly attributes the learning of grammatical behavior to the child's ability "to make complex abstractions and to generalize from them to diverse new instances" (1970, p. 93), and he mentions in this connection the processes of stimulus generalization and response induction.

Generalizations are always under the control of a particular property or combination of properties, however (e.g., Skinner, 1953, pp. 132–136; 1957, pp. 107–111), so we now arrive at a fundamental question: What are these properties, and how do they acquire their controlling power? Concentrating on the "passive" ability, our question is thus: What is the property that controls the generalizations that enable us to respond with new passive sentences, and what are the ontogenic contingencies that establish its controlling power for effective listeners and speakers?

Although this is a crucial question, neither Skinner nor MacCorquodale explicitly deal with it. Skinner attributes grammatical behavior mainly to autoclitic learning. He states, for example, that "the grouping and ordering of responses is . . . autoclitic" (1957, p. 332), but it is difficult to extract from his brief analysis a method for arriving at the controlling properties of grammatical generalizations and at the required contingencies.

MacCorquodale discusses the ability to sort the sentences one hears "into classes or subsets having some property in common and differing from other subsets in some property" (1970, p. 94). This ability apparently makes it possible to distinguish passive sentences from active sentences, from questions, from nonsentences, and so forth. MacCorquodale speaks only of *some* property that controls these classes and subsets, however, without mentioning its nature and without specifying the contingencies that make it a controlling property. This account does not satisfy Chomsky and his followers, who feel it is too vague and too sketchy. Perhaps this is one of the main reasons that cognitive psychologists have largely ignored MacCorquodale's article.

What are we to say about MacCorquodale's account? We would probably agree that there is little value to an explanation that attributes generalizations such as those from (a) *The lecturer is interrupted by John* to (b) *The book is held by the man who holds the painting* to control by an unspecified property. Still, it has an important quality; it is based on an extrapo-

lation from an experimentally based theoretical framework. Moreover, Chomsky's alternative nativist hypothesis is not very attractive. Because innate capacities are free for the asking, it is too easy. Instead, sound methodology (as well as evolutionary considerations) suggest that, before postulating an innate mechanism to explain the creative capacity, a serious effort should first be made to explain it in terms of experimentally established learning capacities (cf. Stemmer, 1987a, pp. 97–100).

MacCorquodale's observations, as well as Skinner's discussion of grammatical behavior, presumably point to a research program; this program should eventually enable us to specify (a) the generalization processes that produce grammatical behavior, (b) the contingencies that initiate the processes, (c) the properties that control the generalizations, and (d) the contingencies that give the properties their controlling power. I have started with such a research program in earlier publications (especially in Stemmer, 1971, 1973, 1981, 1987a, 1987b), and in the following section I will state the main conclusions of that program.

STRUCTURE-DEPENDENT GRAMMARS

Let us return to the learning of the word *holds,* and for simplicity let us concentrate on the listener. Previously we have seen that children can learn the structure *x holds y* by undergoing appropriate ostensive contingencies. Expressions such as *holds* will be called *(bi)relational* terms, and the values of the variables *x* and *y,* the *first* and *second arguments.* Thus the following sentences contain the relational term *holds* accompanied by different (first and second) arguments: *Mommy holds the ball, The man holds the book,* and *The man who holds the painting holds the book.* We notice that the nature of the arguments is determined by the nature of the relational word, or, more exactly, by the environmental property that controls the word *holds.* The first arguments are expressions denoting entities that can hold something (i.e., responses that are controlled by such entities), the second arguments are expressions that denote entities that can be held, and the entities denoted by the second argument are those held by the entities that are denoted by the first arguments.

The property that controls each type of argument is not physical. The expressions *Mommy* and *the man* share no (psychologically significant) physical property. Rather, it is a functional property, and its controlling power (with respect to being an argument of *holds*) is established in the contingencies in which the children have learned the expressions and the word *holds.* In other words, the contingencies establish the classes containing the arguments of *holds* as valid generalization classes for the children.

It is important to realize that each relational term determines the specific nature of its arguments. The arguments for *holds* are different from those of *receives, buys,* or *is bigger than.* Their nature is determined by the nature of (a) the contingencies that gave the relational terms their "meanings" (i.e., the contingencies that, for each relational term, conferred controlling power to a particular environmental property or properties) and (b) the contingencies that gave the arguments their "meanings."

Arguments, too, can be structured. For example, the clause *the man who holds the painting* is the first argument in (c) *The man who holds the painting holds the book.* This clause is a structure, and its nature is determined by the relational word *who,* which determines the structure *x who y.* In our example, the first argument of *who* is *the man* and its second argument is *holds the painting.* The nature of these arguments is determined by the abovementioned contingencies, in particular, the contingencies that establish a particular property of the verbal and nonverbal environment as the controlling feature of *x who y.*

Substructures, as well as their elements, often have properties that are determined by "higher" structures. For example, the structure of (c) *The man who holds the painting holds the book* determines that the second occurrence of *holds* has the status of being the main relational term of (c), whereas the first occurrence, which occurs in a substructure, has the status of a secondary relational term.

The learning of relational words such as *who* or *which* has often been neglected. It is clear, however, that these words have specific meanings, which implies that they must be learned in specific contingencies, usually contextual contingencies. Moreover, because of their particular relational character, the words play a prominent role in the formation of substructures. It is therefore very important to give a correct account of the processes and contin-

gencies by which such relational words are learned (cf. Skinner, 1957, pp. 347–348).

We will now see that grammatical generalizations are based on structural properties. I will begin with the semantic relation between active and passive sentences. Suppose that a young girl, who has never heard a passive sentence, has already learned to understand the sentence (d) *Daddy receives the book.* That is, appropriate contingencies have established the property of Daddy receiving a book as a controlling property of (d). Among these contingencies are those by which she learned the structure *x receives y.* The girl now sees her father receiving a book and she hears this event being described with the new sentence (e) *The book is received by Daddy.* This contingency (or various contingencies of this type) establishes a stimulus-controlled generalization: from sentences that have the structure *x receives y* to sentences having the structure *y is received by x,* where *x* and *y* are the first and second arguments of the relational word *receives.* That is, the environmental properties that control responses of the first type of sentence now also control those of the second type.

This generalization gives the girl a creative capacity. If she is able to emit, for instance, *The man who holds the book receives a ball,* she will also be able to emit *The ball is received by the man who holds the book.* Both responses are controlled by the same property. We notice that, in this example, not only the sentence but also the argument *x* is structured.

Moreover, if the girl has already learned other relational terms, then this contingency (or various contingencies of this type) also establishes a wider generalization: from sentences of the structure *xRy* to those of the structure *y is R-ed by x,* where *R* is a relational term and *x* and *y* are the first and second arguments of *R.* Each pair of responses is controlled by the same property. This wider generalization is highly important, because it is no longer restricted to the specific relational word *receives.* Rather, it covers relational words in general.

The wide generalization is effective for the children who have learned the meanings of the relational words; that is, children who underwent contingencies that establish the control of the words by certain environmental stimuli. For these contingencies also have a second effect. They give controlling efficacy to a property that is shared by the words, namely, the functional property "to be a relational term." This property can therefore play its controlling role in the wider generalization. Actually, it is not sufficient for *R* to be a relational term; it must have additional features, in particular those of verbs (Stemmer, 1987a, pp. 105–107). However, these features, too, are controlling properties established by contingencies.

Our conclusions now account for the passive capacity. If children are able to emit an active sentence, then the wide generalization also enables them to emit the corresponding passive sentence. Similar generalizations allow the children to transform the active sentences into other types of sentences such as interrogative or negative sentences.

What about the active sentences themselves? The structures of these sentences are usually learned individually. They are learned when, with the help of appropriate contingencies, the children learn the meanings of the relevant relational terms. This learning includes the learning of the corresponding structures, as in *x holds y.* Children do undergo these contingencies, because everyone admits that children must learn the meaning of every lexical root individually. (Actually, some roots may be learned when they occur in a passive sentence, in a question, etc. In these specific cases, the generalizations go from [say] passive sentences to corresponding active or interrogative sentences.) Consequently, we can account for children's capacity to emit active sentences as well as corresponding passive, interrogative, negative, or imperative sentences. The former are individually learned, whereas the latter are the product of appropriate generalizations. This account therefore radically differs from the one given by semanticists (e.g., Bowerman, 1976; Braine & Hardy, 1982; Schlesinger, 1982) who attribute the capacity to emit active sentences to generalizations rather than to individual learning. These generalizations are based on properties such as *actor* or *action*; however, the intrinsic defects of this account are discussed in Stemmer (1973, pp. 125–127, 1987a, pp. 114–117).

It is important to realize that the properties that control the generalizations we have discussed are not abstract. They are functional properties that control concrete stimuli. For example, "to be a relational term" is a contingently established functional property that controls concrete relational terms (i.e., the specific terms that occurred in the relevant con-

tingencies). Similarly, the structures we have discussed have no special status. They derive from the relational character of the relevant terms (i.e., from the fact that relational terms always have arguments). Finally, the classes containing the arguments of relational words are valid generalization classes. They are determined by contingently established functional properties.

There are many more properties that control our grammatical generalizations, such as being a verb, a noun, or an adjective. It can be shown that these properties, too, acquire their controlling power through appropriate contingencies (see, e.g., Stemmer, 1971, 1973, pp. 70–71, 1987a, pp. 105–106. Psycholinguists often use the term *distributional analysis* to refer to such contingencies and their effects (e.g., Maratsos, 1982).

The account I have given here of the learning of grammatical behavior is of course merely an hypothesis. However, it has all the features mentioned in connection with the learning of *holds*. Note in particular that children must undergo the contingencies that, according to the hypothesis, confer controlling properties to certain properties. Thus, children who are able to emit *The ball is received by the man who holds the book* on appropriate occasions must have undergone the contingencies by which they learned relational words, in particular, the word *who* and the relational roots of *to receive* and *to hold*. We recall that such contingencies also give controlling efficacy to the functional property "to be a relational term." Moreover, they must have heard at least once a passive sentence and noticed its relation to a corresponding active one (or vice versa). We can therefore conclude that this hypothesis, which agrees with Skinnerian views, is a plausible one.

The account is not only plausible, but it is more plausible than the main alternative hypotheses that are being discussed nowadays: the nativist hypotheses proposed by Chomsky and others, and the semanticist hypotheses. I have already mentioned that the latter have intrinsic defects, and in Stemmer (1987a, 1987b) I discuss the shortcomings of the former. Let me mention here one of these shortcomings (Stemmer, 1987b, p. 142). Nativists assume that syntactic categories such as noun phrase or verb phrase are somehow innate. By classifying expressions into these categories, children can then acquire a structure-dependent grammar. But to assume that the categories are innate is not sufficient. One must also explain the children's capacity to classify expressions—concrete items such as *the man who holds*—into the categories. Because nativists surely admit that this capacity is not innate, they must explain how it is acquired. Do children learn this, and if so, what are the learning processes (e.g., conditioning processes) and what are the contingencies that are required for this? A perusal of the literature shows that nativists have ignored these issues completely. Clearly, as long as these fundamental questions have not been answered, one cannot say that there exists a nativist theory of grammatical competence or grammatical behavior.

Chomsky (1975, pp. 31–33) discusses an example that shows that children's grammatical generalizations are structure dependent. Because Chomsky believes that behaviorist (and empiricist) hypotheses cannot account for structure-dependent generalizations (e.g., 1975, pp. 178–204), the example is offered as proof that these theories are false. We will now see that Chomsky is mistaken. (I have made some minor changes in the example.)

Suppose a child has learned to form questions by hearing the pairs *The man is tall—Is the man tall?* and *The book is on the table—Is the book on the table?* Chomsky believes that behaviorist (and empiricist) theories attribute the child's generalization from these examples to the following controlling property: the first occurrence of the word *is* of the active sentence is transferred to the beginning of the corresponding question. However, Chomsky observes, this controlling property, which is not structure dependent, would transform the active sentence (f) *The man who is tall is in the room* into (g) *Is the man who tall is in the room?* Yet, "children make many mistakes in language learning but never mistakes such as exemplified in [g]" (Chomsky, 1975, p. 31). Rather, they unerringly form the correct question (h) *Is the man who is tall in the room?* (if they can handle the example). This proves that the children's generalization is based on a structure-dependent controlling property, which requires analyzing sentences into phrases that "are *abstract* in the sense that neither their boundaries nor their categories (noun phrase, verb phrase, etc.) need to be physically marked" (1975, p. 32). Chomsky's conclusion is that the child's mind "contains the instruction: Construct a structure-dependent rule, ignoring all

structure-independent rules. The principle of structure-dependence is not learned, but forms part of the [innate] conditions of language learning" (1975, pp. 32–33).

We have seen, however, that there is no need to adopt this nativist conclusion. When children learn *is,* they do not learn the isolated word but the structure *x is y.* And this structure, rather than innate factors, determines the structure of (e). In particular, the second occurrence of *is* is the main relational word and the first occurrence is secondary; it occurs in the substructure *the man who is tall.* Now when children, by generalizing from appropriate instances, learn to transform active sentences into questions, the generalization will be controlled by the functional property "to be a relational term" (among others). Therefore, the generalization does not simply transform certain word sequences into other word sequences but rather certain structures into other structures. To be sure, the features and properties that control the generalization are not physical. But they are not abstract either. They are functional properties that control concrete bits of verbal behavior, and they receive their controlling efficacy in contingencies that children indeed undergo. (We recall that children learn individually the lexical root of every word, and this includes *is*.) Consequently, contrary to Chomsky's claim, a Skinnerian hypothesis can account for the structural property that controls the emission of question (h).

CONCLUSIONS

There are two main reasons why natural languages have structure-dependent grammars. First, they all have relational words. Because these words have arguments, they give origin to structures and substructures. Second, all these languages permit transformations of certain structures into others.

Children learn grammatical behavior with the help of three types of contingencies (that may overlap). The first are the contingencies by which children learn relational words and the words that occur in the corresponding arguments. The second are the contingencies that give controlling efficacy to functional properties, such as the property of being a relational word or of being an argument of *holds.* The third are the contingencies that give origin to grammatical generalizations. These generalizations permit the transformation of the structures determined by the relational words into other structures, and the controlling properties of the generalizations are appropriate functional properties. Because the learning processes that are initiated by the contingencies are operant or respondent conditioning processes or related processes such as those that produce stimulus equivalence, we can conclude that Skinnerian frameworks account for grammatical behavior. There is no need to adopt mentalist approaches or to add mentalist assumptions to behaviorist theories.

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